10125

# INSTRUCTION BOOK

## MODEL 91C

## RF VOLTMETER

Do not use on Ser. Nos. below 2361

Boonton ELECTRONICS Corporation

MORRIS PLAINS, NEW JERSEY

Ser. No. 3270

# 10125

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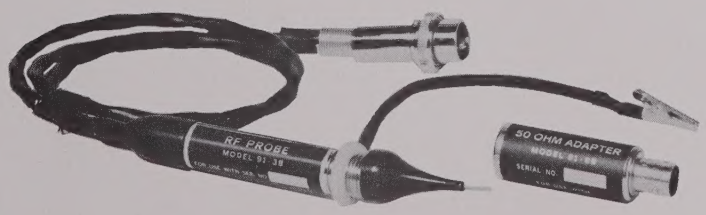


**Boonton *ELECTRONICS* Corporation**

738 SPEEDWELL AVENUE, MORRIS PLAINS, NEW JERSEY, U. S. A.

1015

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## SECTION I

## MODEL 91C

## SPECIFICATIONS

| | | |
|---|---|---|
| 1.1 | Measurement Range: | 1 millivolt to 3 volts |
| 1.2 | Full Scale Ranges: | .003, .01, .03, .1, .3, 1, 3 volts |
| 1.3 | Frequency Range: | 10 KC to 600 MC |
| 1.4 | Accuracy: | 5% of full scale to 200 MC<br>10% of full scale above 200 MC |
| 1.5 | Input Impedance: | 91-3B RF Probe<br>See curve for shunt resistance data on high impedance probe. Shunt capacitance varies inversely with input voltage from 2 to 5 μμf.<br>91-3B BNC Adapter<br>Max. VSWR 1.2 up to 600 MC |
| 1.6 | Tube Complement: | 1 each: 12AX7, 12AT7, 6AU6, OA2 and 6X4. |
| 1.7 | Power Requirements: | 105-125 volts, 55-65 ∿, 30 watts. |
| 1.8 | Dimensions | 7-1/4 W, x 9-1/2D x 11 H excluding handle |
| 1.9 | Weight | 12 pounds |

## SECTION II

## GENERAL DESCRIPTION

The 91C RF Voltmeter is a sensitive instrument for the measurement of voltages of 1 millivolt to 3 volts spanning a wide frequency range of 10 kilocycles to 600 megacycles. In addition to conveniently measuring voltage levels in a diversity of rf circuits, the instrument has application for many associated tests. Such measurements include: the frequency response of both active and passive networks, i.e., amplifiers and filters; VSWR and return loss on transmission lines and attendant systems; attenuation and insertion loss of rf attenuators; and high frequency parameters of transistors. With true rms response below 0.03 volt (up to 3 volts with the 91-7B, 100:1 divider), wide band noise can be measured, and using suitable null networks measurement of the harmonic distortion of RF waveforms can be performed without the attendant errors of average type meters.

The instrument is also useful as an rf null detector for bridge measurements and analogous techniques when a sensitivity in the order of 300 microvolts will suffice.

Supplied with each instrument is a general purpose probe, 50 ohm adapter, and probe tip. The adapter is fitted with a BNC coaxial connector and provides a 50 ohm termination with a low VSWR up to at least 600 megacycles. The probe tip and companion ground clip are useful for direct measurement to approximately 100 megacycles. Above 100 megacycles, the probe may be used directly without the tip or ground clip, but the connecting leads must be extremely short to avoid resonant effects. In the special case where it is possible to connect the probe directly to the voltage source, the specified tolerance is maintained to at least 600 megacycles. The impracticability of such a connection, however, precludes our assuring the accuracy of the 91CA RF Voltmeter above 250 megacycles without the use of the 91-8B BNC 50 ohm adapter.

The 91-3B probe with its full-wave crystal detecting circuit produces a true rms response without turnover, or harmonic errors for all voltage levels below 0.03 volt , gradually changing to peak-to-peak reading (calibrated in rms) at approximately 1.0 volt. The probe has a shunt capacitance of approximately 2.5 μμf at levels of 0.3 volt or higher, increasing slightly at levels of 0.1 volt or less. The shunt resistance component shown in Figure 1 is a variable factor, depending on the voltage and frequency.

Figure 1 also shows the input resistance of the 91-7B, 100:1 voltage divider. When the frequency and the voltage to be measured permit, consideration should be given to the use of the 91-7B. In addition to extending the voltage range of the instrument to 300 volts, the benefit is threefold: the input resistance is increased above that available with vacuum tube diode probes, and the diode overload protection as well as the range of true rms response is increased by a factor of 100. The 100:1 divider may be used at frequencies up to 250 megacycles with negligible loading for most rf circuitry.

Boonton *ELECTRONICS* Corp.
MORRIS PLAINS, N.J.

# APPROXIMATE RESISTANCE CHARACTERISTICS
## *91-3B HIGH IMPEDANCE PROBE*
## RF VOLTMETER-SERIES 91 & 85

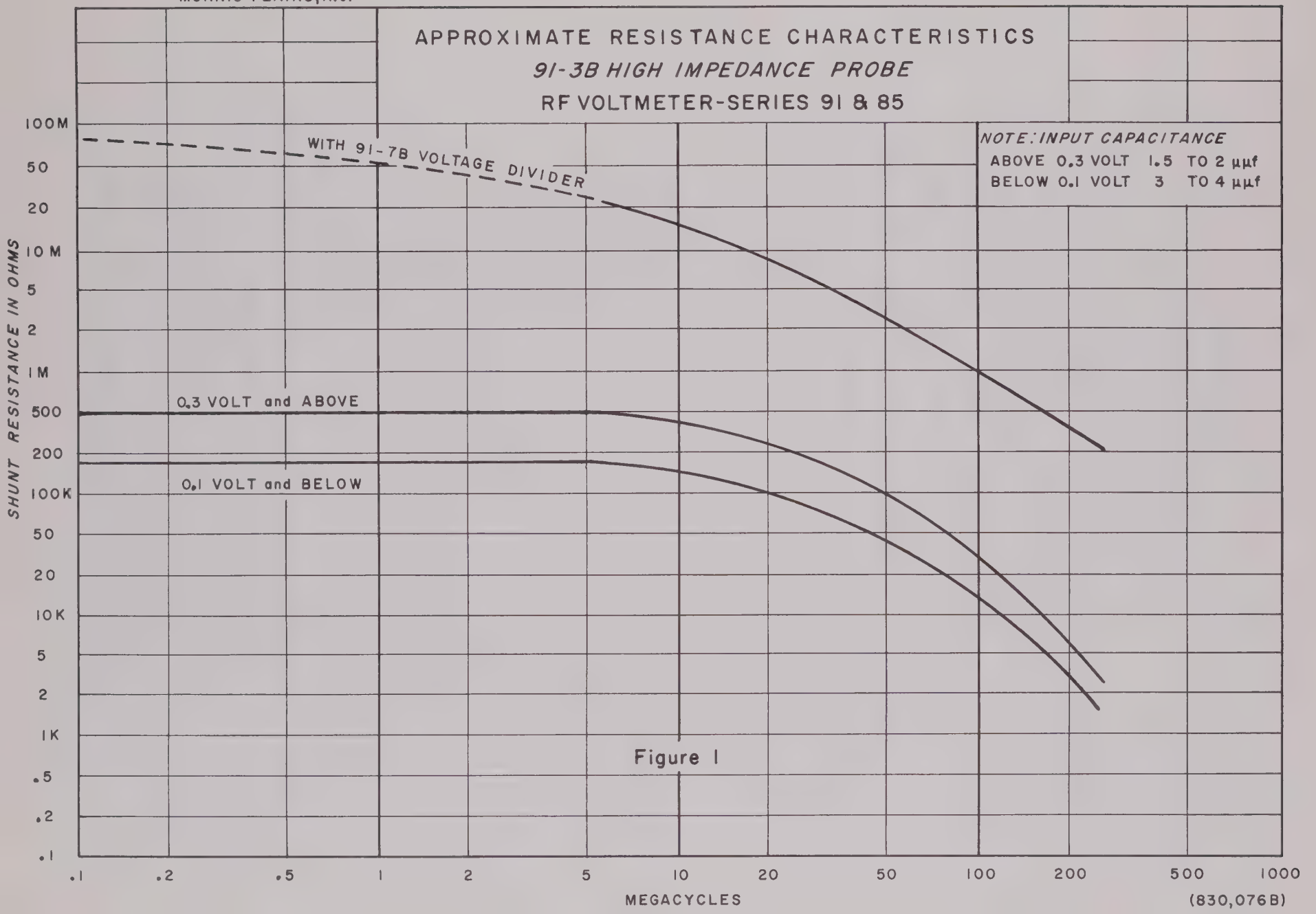



Figure 1

(830,076B)

## SECTION III

## OPERATING PROCEDURE

3.1 General

3.2 This section describes in detail the operating procedure for the 91C RF Voltmeter. All information required for safe and proper operation of the instrument is included. Be sure to read this section before placing the instrument into operation.

3.3 Initial Turn-On Procedure and Tests

3.4 Tests To perform the initial tests proceed as follows:

a. After unpacking the unit, and before plugging it into an ac outlet for the first time, turn the instrument back and forth several times to make sure the tubes have not fallen from their sockets due to rough handling.

b. Observe the meter pointer to see that it moves freely and rests at zero when the instrument is steady.

c. If the pointer rests to the right or left of zero, set it at zero with the zero set screw.

CAUTION

Before plugging the instrument into the convenience outlet, make sure the power supply is 105-125 volts ac, 55-65 ∿, unless otherwise specified on nameplate.

3.5 Turn-On Procedure. To perform the initial turn-on procedure proceed as follows:

a. Plug the instrument into the power source.

b. Set the toggle switch to ON (up), and allow a warm-up period of approximately one minute.

c. Connect probe cable assembly to the instrument at jack marked PROBE. Check serial number of probe and see that it is the same as that of the voltmeter.

d. Check meter deflection on all ranges with probe tip shorted to probe case ground. Normal meter deflections are as follows:

| RANGE | DEFLECTION |
|---|---|
| .003 | less than 1/8 inch |
| .01, .03, .1, .3, 1 | Zero |
| 3 | Suppressed |

3.6 Measurement Procedure

a. Set RANGE-FULL SCALE control to appropriate setting (or higher) for voltage to be measured.

b. Connect probe ground clip to ground point of voltage source under test. This connection must be as short and direct as possible to minimize errors arising from circulating RF currents in the ground return impedance.

c. Connect probe tip to high point of voltage source under test. This connection must also be as short as possible to minimize resonance rise effects at frequencies above 100 megacycles.

d. Read RF voltage on appropriate meter scale corresponding to setting of RANGE-FULL SCALE control.

e. To obtain relative level readings in decibels add the DB (red scale) meter reading to the DB (red)setting of the RANGE-FULL SCALE control. Although individual DB readings have no significance as measured on the 91 type RF Voltmeter the difference between two DB readings represents the actual change in level on a decibel basis. When used with a good signal generator the DB scale greatly facilitates the measurement of relative attenuation and bandpass characteristics of networks.

f. As it is frequently desired to measure RF voltages in coaxial systems the Model 91 is provided with a 50 Ω coaxial adapter having a low VSWR up to 600 MC.

3.7 Operating Precautions

3.8 Maximum Input Voltages

RF voltages exceeding 10 volts must not be applied to the probe or permanent damage to the crystal diodes may result. The 50 Ω adapter should not be subjected to continuous overloads exceeding 10 volts to avoid excessive heating of terminating resistor.

Maximum DC voltage for HI-Z probe is 300 volts.

Maximum DC voltage for 50 Ω adapter is 10 volts.

Note: Do not apply maximum DC voltage simultaneously with maximum RF voltage when using 50 Ω adapter

3.9 Temperature Effects

The normal ambient temperature range for specified accuracy is 65° to 90° F. Appreciable inaccuracies can be expected while the probe is exposed to temperatures above or below this range. No permanent change in probe characteristics will result from the high or low temperature exposure.

Inaccuracies due to temperature effects may occur after soldering to the probe tip or from heat sources such as resistors or tubes.

When making low level measurements in the order of 2 millivolts or less, it is important to make sure that the probe has attained a uniform temperature throughout. A temperature difference between the inside and outside of the probe can generate a small thermal voltage that may add to or subtract from the DC voltage generated by the diodes.

3.10 Hum, Noise and Spurious Pick-up

When measuring low level RF voltages, precautions should always be taken to avoid the possibility of erroneous readings resulting from hum, noise, or stray RF pick-up. Although all low frequency hum and noise is attenuated at the input by 60 db, it is still possible for high level unwanted signals to get through and cause errors. The best test for this condition is to reduce the test signal to zero level and note whether the voltmeter continues to read some spurious signal level. In some cases it may be necessary to provide extra shielding around the probe connections to reduce stray field pick-up. Typical sources of spurious radiation are induction or dielectric heating units, diathermy machines, local radio transmitters, grid dip meters and amplifiers with parasitic oscillatons.

## SECTION IV

## THEORY OF OPERATION

An understanding of the operating features of the Model 91 Sensitive RF Voltmeter may be obtained by a study of the block diagram (Fig. 2) in conjunction with the following description.

The radio frequency voltage to be measured is rectified in the RF Probe by means of a full wave germanium diode rectifier circuit. The resulting DC potential is then attenuated as required before conversion to 60 ∿ AC by the chopper. This AC signal is then amplified in a narrow band feed-back stabilized amplifier prior to its re-conversion to DC for use in actuating the meter.

The germanium diodes used in the RF Probe have been carefully selected for several characteristics. As the selected diodes do not all exhibit the same rectification efficiency characteristics, it becomes necessary to adjust each meter range to match individual probe diodes. The range adjustments consist of individual non-linear circuits shunting the output meter circuitry. As the RANGE switch is set to the required test voltage position the appropriate non-linear adjusting circuit is automatically shunted across the output. It is also important to understand that the non-linear output circuitry is designed to compensate for the non-linear characteristics of the probe diodes when operating at levels below .3 volts.

## SECTION V

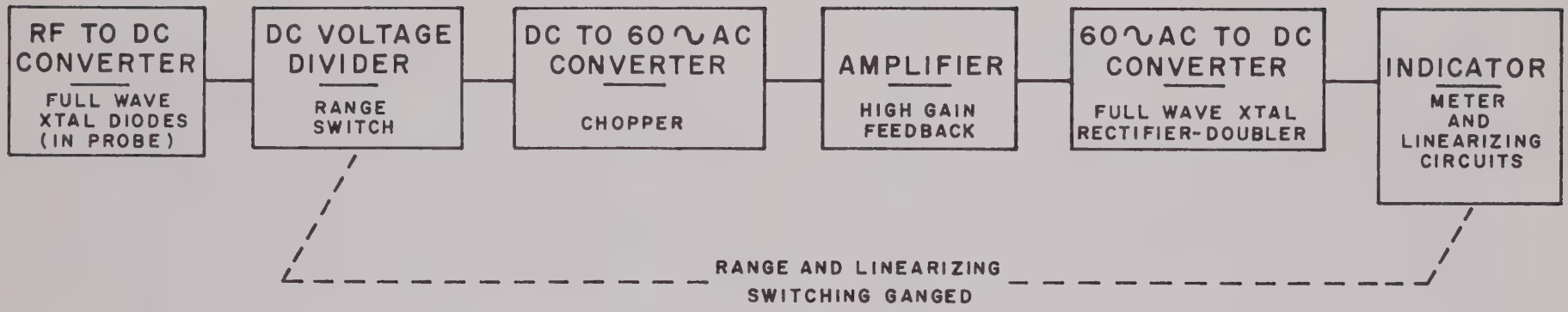
## MAINTENANCE

### 5.1 Periodic Checking

The Model 91C Voltmeter is designed to give long periods of service without maintenance when operated in accordance with these instructions. It is recommended, however, that the instrument be checked occasionally using reliable standards to insure against errors resulting from deterioration of tubes or chopper. To make these checks, it is necessary to have a signal source in the 200 to 500 KC region with less than 2% distortion at levels up to 3 volts across 50 Ω. A precision electronic voltmeter of the averaging response type, such as the Ballantine Model 310A or 314, Hewlett Packard Model 400D or 400H, may be used to monitor the signal source for this purpose. To insure its accuracy, the monitoring meter should be checked at some low frequency (50-100 ∿) of good waveform against a dynamometer type AC meter of at least 1% accuracy.

### 5.2 Calibration Precautions

When attempting to check the voltage calibration accuracy on an instrument having the sensitivity and bandwidth of the Model 91C, it is essential to take precautions to avoid errors resulting from stray pick-up voltages. (See paragraph 3.10). A well shielded signal source must be used in conjunction with coaxial connections to both the Model 91C and the standard reference meter. Even with a well shielded generator and associated connections, it is sometimes possible for the reference meter to pick up stray RF signals and feed them into the probe. Check for this condition by disconnecting standard meter and noting change in level.




**BLOCK DIAGRAM**

TYPE 91, RF VOLTMETER

Figure 2

(A830,071A)

5.3 Calibration Check Procedure

With suitable calibrating equipment (paragraph 5.1) and taking necessary precautions (paragraph 5.2), we can now check the Model 91C for calibration accuracy. Each range should be checked at a voltage representing 90% of full scale value. If these check points agree within ± 2% of the standard, it is recommended that no adjustment be made. If the check points deviate by more than ± 5% from the standard, it is recommended that a trouble shooting procedure be followed as outlined in paragraph 5.4. If the check points fall between 2% and 5% of the standard, the calibration adjustment procedure as outlined in paragraph 5.5 should be followed.

5.4 Trouble Shooting Procedure

a. Case Removal

The instrument may be removed from its case after first removing the two screws located at the back of the case (near the bottom) and the four screws located on the sides of the case near the front.

The power supply may be removed from the case after first removing the four screws located on the sides of the case near the rear.

b. Tube Replacement

If the tube V1 should become weak or noisy, it should be replaced with BEC 525001 or a commercial low noise 12AX7 which has low microphonism and meets the requirements of paragraph 3.5d above. The Telefunken ECC83/12AX7 has been found to consistently meet these requirements. After replacing defective tubes, re-check calibration as outlined in paragraph 5.3 and adjust if necessary as described in paragraph 5.5.

c. Chopper Replacement

If a satisfactory operation is not obtained by replacing

tubes, a replacement chopper should be tried. If the new chopper does not clear the difficulty, place the original chopper back in socket. If new chopper does clear the difficulty, the calibration accuracy must be re-checked and adjusted, if necessary.

d. Voltage and Resistance Tests

After determining that the trouble cannot be cured by replacement of tubes or chopper, as described previously, it is advisable to make a systematic check of AC voltage, DC voltage and resistance at each socket pin. Table I shows the nominal AC and DC voltages to ground from each socket pin number. Table II shows the nominal resistance values expected for each point. Large or erratic deviations from the listed values of voltage or resistance will serve as a valuable clue in tracking down a faulty component. Once the trouble has been found and corrected, the calibration must be re-checked and re-adjusted as outlined in paragraph 5.3 and paragraph 5.5.

5.5 Calibration Adjustment Procedure

Before making any calibration adjustments, it is essential to provide the necessary reference standards as described in paragraph 5.1 and take all precautions as outlined in paragraph 5.2. The calibration adjustment procedure shall then be made as outlined in Table III.

TABLE I

VOLTAGE MEASUREMENTS

Conditions:

117V 60∿ line input.

VTVM used for all measurements.

All measurements to chassis unless otherwise noted.

Input .01V at any frequency between 100 KC and 1 MC.

Use Ballantine Model 314 VTVM for all AC voltage measurements.

| Pin # | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tube | DC | 78 | 0 | .83 | 53 | 53 | 95 | 0 | .9 | 46 | - | - |
| V1 BEC 525001 | AC | 2.5mv | 1.5mv | | | | .14V | 2.5mv | | | - | - |
| | DC | .82 | 2 | 59 | 53 | 30 | 45 | 2 | - | - | - | - |
| V2 (6AU6) | AC | .076V | | | | .86V | | | | | | |
| | DC | 135 | | 2.3 | 53 | 53 | 250 | 53 | 74 | 53 | - | - |
| V3 (12AT7) | AC | 27V | .76V | | | | | 25V | 25V | | - | - |
| | DC | | | 53 | 53 | | | 300 | | | | |
| V4 (6X4) | AC | 235 | | | | | 235 | | | | | |
| | DC | 150 | | | | 150 | | | | | | |
| V5 (OA2) | AC | | | | | | | | | | | |
| | DC | 53 | 53 | | | 53 | | 150 | 250 | 0 | 46 | 59 |
| 11 Pin socket | AC | | | | | | | | | | | |
| | DC | | | | | | | | | | | |
| Chopper Socket | AC | | | 1.5 mv | | | | | | | | |
| Pin 10 to Pin 11 of 11 Pin Socket | | | | DC 12.6V<br>AC .36V | | | | | | | | |
| Pin 10 to Pin 5 of 11 Pin Socket | | | | DC 6.3V<br>AC .015V | | | | | | | | |

TABLE II

RESISTANCE MEASUREMENTS

Conditions:

Power turned off.

Tubes in sockets, chassis interconnected (11 Pin), all measurements to chassis.

| Pin # | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Tube | | | | | | | | | | | |
| V1 BEC 525001 | 1M | 6.8M | 11K | 16K | 16K | 500K | 2.2M | 6.8K | 16K | - | - |
| V2 (6AU6 | 2.5M | 3.8K | 16K | 16K | 500K | 1M | 3.8K | - | - | - | - |
| V3 (12AT7) | 135K | 1M | 2.2K | 18K | 18K | 55K | 500K | 18.5K | 18K | - | - |
| V4 (6X4) | 300 | - | 19K | 19K | - | 300 | 50K | - | - | - | - |
| V5 (OA2) | 50K | 0 | - | 0 | 50K | - | 0 | - | - | - | - |
| 11 Pin Conn. | 19K | 19K | - | - | 17K | - | 45K | 60K | 0 | 16K | 16K |

TABLE III

CALIBRATION ADJUSTMENT PROCEDURE

| Step | Reference Std. Voltage | Voltage Range Setting Model 91CA | Adjust to read | Adjusting Screw No. | Notes |
|---|---|---|---|---|---|
| 1 | .300 | 1 | .30 | 1 | Adjusting screws numbered from front to rear on right side of cabinet No. 1 is gain adjustment. |
| 2 | 2.50 | 3 | 2.50 | 2 | Meter bias adjustment affects up scale readings most. |
| 3 | .900 | 1 | .90 | 3 | Slope adjustment, affects full scale readings more than down scale readings. |
| 4 | .280 | .3 | .280 | 4 | Slope adjustment, affects full scale readings more than down scale readings. |
| 5 | .0300 | .1 | .0300 | 5 | Gain adjustment, affects all ranges from 1 volt to .003 volts. |
| 6 | .0900 | .1 | .0900 | 6 | Slope adjustment affects upper readings most. |
| 7 | .0280 | .03 | .0280 | 7* | Slope adjustment affects upper readings most. |
| 8 | .00900 | .01 | .00900 | 8* | Slope adjustment affects upper readings most. |
| 9 | .00280 | .003 | .00280 | 9* | Slope adjustment, affects upper readings most. |

*These adjusting screws are numbered from back to front on left side of cabinet.

## WARRANTY

Boonton ELECTRONICS Corporation guarantees to the original purchaser that each instrument it manufactures be free from defects in material and workmanship for a period of one year after date of initial shipment. Our liability is limited to repairing or replacing any defective part with the exception of vacuum tubes, panel lamps, fuses, and batteries. The warranty lapses if, upon our examination, we judge that the instrument has been abused in any way.

## PROCEDURE TO FOLLOW WHEN INSTRUMENT IS DEFECTIVE

1. Call our plant or our representative nearest you. A simple solution may result from discussion of the problem with our trained personnel.
2. If the fault is not readily eliminated, prepare the instrument for return to us. Pack carefully in a sturdy container using several inches of shock absorbing material on all six sides of the instrument. Include all probes, cables or accessory units. On all paper work pertaining to the returned instrument, note the model and serial number and state briefly the details of the fault. Ship to us transportation charges prepaid.
3. If the instrument is within the warranty, we will repair and return to you transportation charges prepaid. If the instrument is beyond the one year warranty period, we will repair and return it unless approval on a cost estimate is requested. If the instrument is within the one year warranty period, but our examination reveals abuse, we will await approval of our cost estimate before proceeding with repairs.

## PARTS LIST

## FOR 91C AND 91CA

| Reference | | Description | | | BEC Part No. |
|---|---|---|---|---|---|
| C1 | Capacitor, Mylar | 0.1 | µf | 200V | 230,116 |
| C2 | " Mylar | 0.1 | µf | 200V | 230,116 |
| C3 | " Mylar | 0.1 | µf | 200V | 230,116 |
| C4 | " Mylar | 0.1 | µf | 200V | 230,116 |
| C5 | " Mylar | 0.0033 | µf | 200V | 230,119 |
| C6 | " Mylar | 0.022 | µf | 200V | 230,101 |
| C7a | " Elect. | 20 | µf | 475V | 283,109 |
| C7b | " Elect. | 50 | µf | 50V | |
| C7c | " Elect. | 20 | µf | 25V | |
| C8 | " Mylar | 0.005 | µf | 200V | 230,121 |
| C9 | " Elect. | 50 | µf | 6V | 283,112 |
| C10 | " Elect. | 50 | µf | 6V | 283,112 |
| C11 | " Mylar | 0.1 | µf | 200V | 230,116 |
| C12 | " Mica | 1000 | µµf | 500V | 201,143 |
| C13 | " Mica | 1000 | µµf | 500V | 201,143 |
| C14 | " Mica | 1000 | µµf | 500V | 201,143 |
| C15 | " Mylar | 0.005 | µf | 200V | 230,121 |
| C16 | " Mylar | 0.1 | µf | 200V | 230,116 |
| C17 | " Mylar | 0.01 | µf | 300V | 230,120 |
| C18 | " Elect. | 50 | µf | 6V | 283,112 |
| C19 | " Met.Paper | 1.0 | µf | 200V | 230,104 |
| C20 | " Met.Paper | 1.0 | µf | 200V | 230,104 |
| C21 | " Elect. | 50 | µf | 6V | 283,112-91CA only |
| C27a,b,c | " Elect. | 20-20-20 | µf | 475V | 283,113 |
| C28a,b | " Elect. | 1000-1000 | µf | 15V | 283,114 |
| C29 | " Ceramic | .001 | µf | 500V | 224,115 |
| C30 | " Ceramic | .001 | µf | 500V | 224,115 |
| C31 | " Ceramic | .001 | µf | 500V | 224,115 |

| Reference | | Description | BEC Part No. |
|---|---|---|---|
| CH-1 | Chopper, 91CA only | BBM-Special | 540,108 |
| CH-1 | Chopper, 91C only | Stevens Arnold | 540,103 |
| CR-1 | Rectifier, Sel. | Sarkes-Tarzian #304B | 432,001 |
| D1 | Diode | 1N600 | 530,008 |
| D2 | Diode | 1N600 | 530,008 |
| D3 | Diode | SG22 | 530,009 |
| D4 | Diode | SG22 | 530,009 |
| D5 | Diode | Special | 530,000 |
| D6 | Diode | Special | 530,000 |
| F1 | Fuse | AGC 0.5 Amp | 545,502 |
| I1 | Lamp | #51 | 545,103 |
| I2 | Lamp | #51 | 545,103 |
| I3 | Lamp, 91C only | #47 | 545,101 |
| J1 | Receptacle | Amphenol 80-PC-2FT | 479,119 |
| J2 | Socket | Amphenol 77-MIP-11 | 472,101 |
| J3 | Receptacle | Amphenol UG-290/U | 479,107 |
| L1 | Choke | Stancor #C1707 7HY | 440,001 |
| M1 | Meter | Special 0-200 μa | 554,135 |
| P1 | Plug (Input Cable) | Amphenol 80-MC-2M | 479,101 |
| P2 | Plug (Amplifier) | Amphenol 86-PM11-11 | 477,105 |
| P3 | Plug & Adapter | P/O AC Line cord | 568,101 |
| R1 | Resistor, Comp. | 330K 1/2W 5% | 301,147 |
| R2 | " | 330K 1/2W 5% | 301,147 |
| R3 | " Dep.Car. | 5 Meg. 1/2W 1% | 306,693 |
| R4 | " " " | 5 Meg. 1/2W 1% | 306,693 |
| R5 | " " " | 576K 1/2W 1% | 306,570 |

| Reference | | Description | | | BEC Part No. | |
|---|---|---|---|---|---|---|
| R6 | Resistor, Dep.Car. | 576K | 1/2W | 1% | 306,570 | |
| R7 | " " " | 47.5K | 1/2W | 1% | 306,440 | |
| R8 | " " " | 47.5K | 1/2W | 1% | 306,440 | |
| R9 | " " " | 6.81K | 1/2W | 1% | 306,339 | |
| R10 | " " " | 6.81K | 1/2W | 1% | 306,339 | |
| R11 | " " " | 1.39K | 1/2W | 1% | 306,694 | |
| R12 | " " " | 1.39K | 1/2W | 1% | 306,694 | |
| R13 | " " " | 675 | 1/2W | 1% | 306,695 | |
| R14 | " " " | 675 | 1/2W | 1% | 306,695 | |
| R15 | " " " | 2K | 1/2W | 1% | 306,276 | |
| R16 | " Comp. | 6.8 Meg. | 1/2W | 5% | 301,179 | |
| R17 | " " | 47K | 1/2W | 5% | 301,127 | |
| R18 | " " | 1 Meg. | 1/2W | 5% | 301,159 | |
| R19 | " Dep.Car. | 845 | 1/2W | 1% | 306,231 | |
| R20 | " " " | 10K | 1/2W | 1% | 306,359 | |
| R21 | " " " | 820K | 1/2W | 5% | 306,598 | |
| R22 | " Comp. | 470K | 1/2W | 10% | 301,029 | |
| R23 | " " | 6.8K | 1/2W | 5% | 301,107 | |
| R24 | " " | 2.2 Meg. | 1/2W | 5% | 301,167 | |
| R25 | " " | 470K | 1/2W | 5% | 301,029 | |
| R26 | " " | 470K | 1/2W | 5% | 301,029 | |
| R27 | " " | 470K | 1/2W | 5% | 301,029 | |
| R28 | " " | 470K | 1/2W | 5% | 301,029 | |
| R29 | " Variable | 2K | 2W | 20% | (10) ADJ 311,114 | 91CA only |
| R30 | " " | 2K | 2W | 20% | (1) ADJ 311,114 | |
| R31 | " " | 2K | 2W | 20% | (5) ADJ 311,114 | |
| R32 | " Dep.Car | 845 | 1/2W | 1% | 306,231 | |
| R33 | " Comp. | 1 Meg. | 1/2W | 5% | 301,159 | |
| R34 | " " | 1 Meg. | 1/2W | 5% | 301,159 | |
| R35 | " Dep.Car. | 1 Meg | 1/2W | 1% | 306,598 | |
| R36 | " Comp. | 100K | 1/2W | 5% | 301,135 | |

| Reference | Description | | | | BEC Part No. | |
|---|---|---|---|---|---|---|
| R37 | Resistor, Comp. | 2.2K | 1/2W | 5% | 301,095 | |
| R38 | " " | 470 | 1/2W | 5% | 301,079 | |
| R39 | " " | 18K | 1/2W | 5% | 301,117 | |
| R40 | " " | 470K | 1/2W | 5% | 301,029 | |
| R41 | " Dep.Car. | 39.2K | 1/2W | 1% | 306,430 | |
| R42 | " " " | 12.1K | 1/2W | 1% | 306,369 | |
| R47 | " Comp. | 22 Meg. | 1/2W | 5% | 301,230 | 91CA only |
| R48 | " " 2 | 22 Meg. | 1/2W | 5% | 301,230 | " " |
| R49 | " Variable | 50K | 2W | 20% BAL | 311,125 | " " |
| R50 | " Comp. | 8.2K | 1/2W | 5% | 301,209 | " " |
| R51 | " " | 8.2K | 1/2W | 5% | 301,209 | " " |
| R52 | " " | 220K | 1/2W | 5% | 301,027 | " " |
| R53 | " " | 24 Ω | 1/2W | 5% | 301,048 | " " |
| R54 | " Variable | 25K | 2W | 20% (9) ADJ | 311,115 | |
| R55 | " " | 25K | 2W | 20% (8) ADJ | 311,115 | |
| R56 | " " | 25K | 2W | 20% (7) ADJ | 311,101 | |
| R57 | " " | 25K | 2W | 20% (6) ADJ | 311,101 | |
| R58 | " " | 50K | 2W | 20% (4) ADJ | 311,163 | |
| R59 | " " | 250K | 2W | 20% (3) ADJ | 311,103 | |
| R60 | " " | 250K | 2W | 20% (2) ADJ | 311,157 | |
| R61 | " Comp. | 220 Ω | 1/2W | 5% | 301,071 | |
| R62 | " " | 1.5K | 1/2W | 5% | 301,091 | |
| R63 | " " | 1.5K | 1/2W | 5% | 301,091 | |
| R64 | " " | 5.6K | 1/2W | 5% | 301,105 | |
| R65 | " " | 8.2K | 1/2W | 5% | 301,109 | |
| R66 | " " | 18K | 1/2W | 5% | 301,117 | |
| R67 | " " | 33K | 1/2W | 5% | 301,022 | |
| R68 | " " | 3K | 1/2W | 5% | 301,098 | |
| R69 | " " | 3.9K | 1/2W | 5% | 301,101 | |
| R70 | " " | 12K | 1/2W | 5% | 301,113 | |
| R76 | " " | 1 Meg. | 1W | 20% | 302,128 | |

| Reference | Description | | | BEC Part No. |
|---|---|---|---|---|
| R77 | Resistor, W.W. | 7.5K | 10W 10% | 312,100 |
| R78 | " Comp. | 5.6K | 2W 5% | 304,105 |
| R81 | These resistors determined by diode characteristics | | | |
| R82 | " " " | " | " " | |
| R83 | " " " | " | " " | |
| R84 | " " " | " | " " | |
| R85 | Resistor, D. P. | 52 Ω | 1/4W 1% | 305,600 |
| S1 | Switch 7 pole 8 pos. | spec. (91CA) | | 466,145 |
| S1 | " 6 pole 7 pos. | spec. (91C) | | 466,144 |
| S2 | " SPST. Carling #110-63 | | | 465,105 |
| T1 | Transformer | Power, special | | 446,007 |
| V1 | Elect. Tube | 12AX7, special | | 525,001 |
| V2 | Elect. Tube | 6AU6 | | 526,6AU6 |
| V3 | Elect. Tube | 12AT7 | | 526,12AT7 |
| V4 | Elect. Tube | 6X4 | | 526,6X4 |
| V5 | Elect. Tube | OA2 | | 526,OA2 |
| W1 | Ground Lead | | | 571,010 |

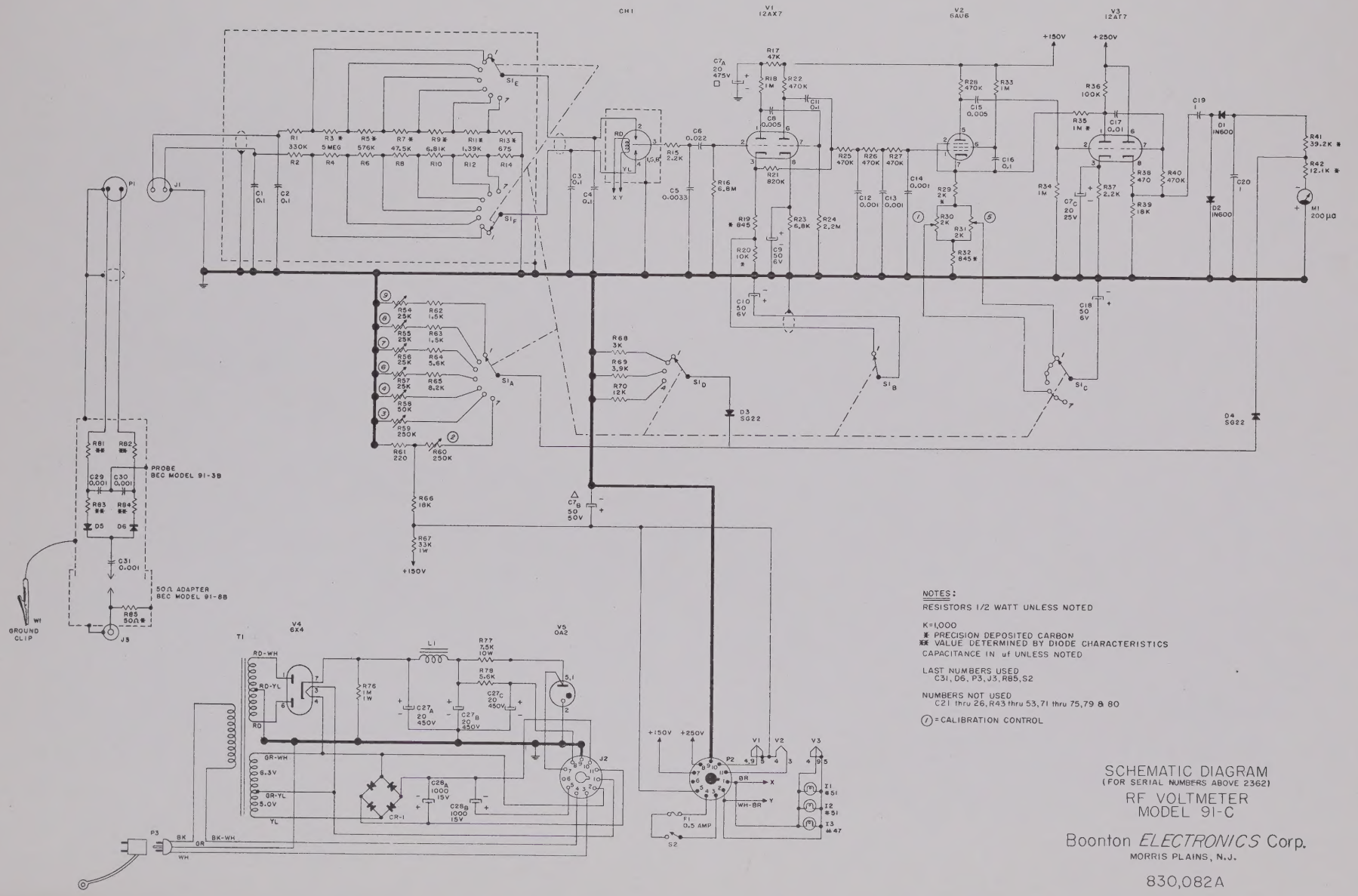
## SECTION VI

## SHIPPING INSTRUCTIONS

6.1 If it becomes necessary to ship the instrument for any reason the following steps should be followed.

a. Wrap the instrument with heavy wrapping paper and seal the seams with gummed tape. Place in fibre-board carton large enough to permit three inches of soft packing material between instrument and sides of box.

b. Separately wrap with heavy paper and pad the proper serial number probe and serialized resistance termination or other probe parts being shipped.




NOTES:

RESISTORS 1/2 WATT UNLESS NOTED

K=1,000

* PRECISION DEPOSITED CARBON

** VALUE DETERMINED BY DIODE CHARACTERISTICS

CAPACITANCE IN uf UNLESS NOTED

LAST NUMBERS USED
C31, D6, P3, J3, R85, S2

NUMBERS NOT USED
C21 thru 26, R43 thru 53, 71 thru 75, 79 & 80

(/) = CALIBRATION CONTROL

SCHEMATIC DIAGRAM
(FOR SERIAL NUMBERS ABOVE 2362)

RF VOLTMETER
MODEL 91-C

Boonton *ELECTRONICS* Corp.
MORRIS PLAINS, N.J.

830,082A

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